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# THE TAIT DYNAMIC SYSTEM OF SKIAMETRY

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We find in optometric books and magazines many articles dealing with Dynamic Skiametry. Unfortunately, almost every discourse on this important subject is taken up with discussions as to why and how the dynamic findings do not agree with the so styled, "court of last appeal," the subjective test. We have this phenomenon explained by various authorities as being due to (a) the fact that the patient does not accommodate exactly to the point of fixation; (b) Faulty fixation targets; (c) the glaring light from the skiascope desensitizing the retina of the patient; (d) Obliqueness of observation and fixation; (e) Normal aberrations in the optical system of the patient; (f) differences in the dioptric values of the retina and the choroid (the former employed in the act of vision and the latter employed in the skiascopic test); and finally we have that which is last because it is most important, the use of an ancient faulty technique.

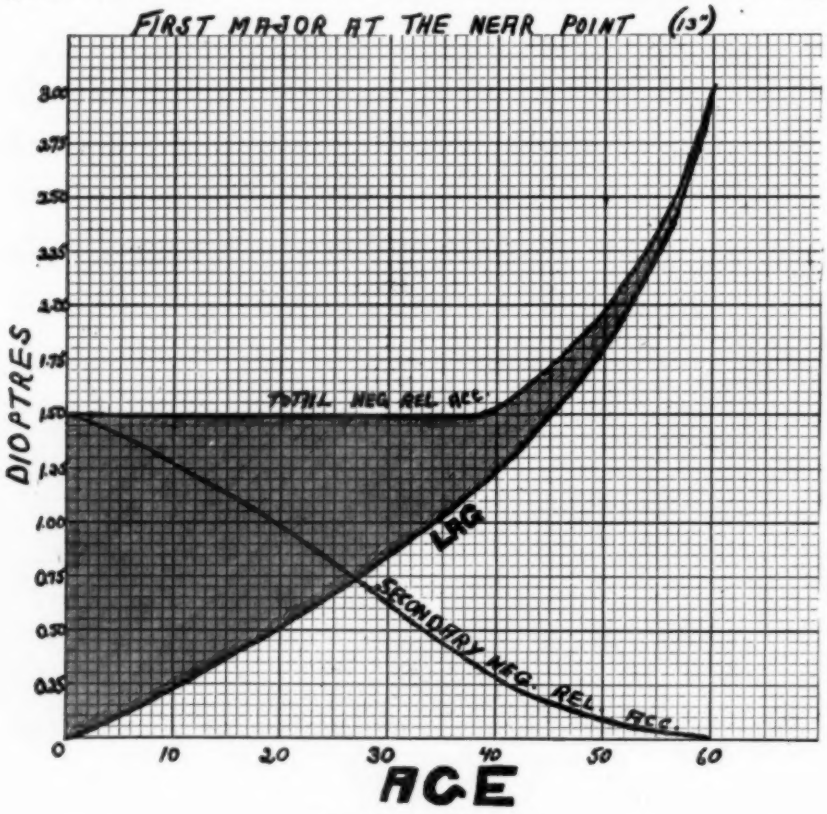
Since every phase but this last has been pretty well discussed, the writer, will attempt to explain the Tait Dynamic system as modified by Dr. E. F. Tait from the previous systems of Drs. Cross, Sheard, and Bestor.

In the first place, let us use the fogging system as employed by Dr. Bestor, and reduce the fog in the right eye (keeping the left or fixing eye about 1.00 D. under a fog), until we arrive at a faster and faster against movement. The dioptric value before the right eye that causes "no faster" against movement in the reflex is our stopping point and is known as the upper edge of the band of fast against movement. Our fixation has been on a chart about 1 cm. to the patient's left of the light from the scope which is operated at "13." This finding for the right eye is recorded and then placed under a 1.00 D. fog. The same process is repeated for the left eye with the patient fixing on the chart to the right of the light from the scope.

The technic, just described, is all there is to the taking of the dynamic findings (obviously, if astigmia be present it is corrected by the proper cylinder at the proper axis), however, what to do with these findings is another matter.

In making the above test at the near point, there were three major factors present, which all told, resulted in the power of the lens found dynamically.

A manifestation of the plus lens power before the eye due to a lack of accommodation in the eye. This plus power amounts to 1.50 D. between the ages of 10 and 40 years and consists graphically of two curves which may be found in any book on Physiological Optics, known as the lag of accommodation behind convergence curve and the ciliary tonicity curve. It is very simple to see why in a fogging technique, a lag of accommodation in the eye becomes manifested as a plus lens value before the eye. By referring to a lag curve one may note that at 10 years of age the value is 0.25 D. and at 40 years of age the value becomes 1.25 D. Now the curve for the ciliary tonicity runs in the opposite direction and falls from 1.25 D. at 10 years of age to 0.25 D. at 40 years of age. The reason we may employ this curve is, that the negative relative accommodation which as we know manifests itself in a plus lens value before the eyes in the fogging technique is equal in dioptres to this ciliary tonicity curve. Now I want you to notice something very important: draw these two curves on the same paper and see what the value of the sum of the curves between the ages of 10 and 40 years becomes. You will find this to be 1.50 D. In this graph,




Graph Number 1.

Number 1, there are two variables of dioptres and age. The two curves (both the Lag curve and the Secondary negative relative accommodation curve) are functions of the age. The third curve is the total of the other two curves. Notice that between the ages of 10 and 40 years the sum of the two curves is about 1.50 D. After 40 years of age, the Lag curve becomes the dominant factor and is the large contributor to the total negative relative accommodation. The shaded portion represents the difference between the "high point" or "first fast against" and the "low point" or "first fast with" motion. For example, when the patient is under the fogging technique a total negative relative accommodation takes place within the eyes that is taken up by the plus lenses before the eyes. The result is that a gradual reduction in the plus power before the eyes gives a faster and faster motion until that point is reached where the eyes begin to employ "retinal accommodation" and thus give the same fast motion to the skiascopic reflex. Now, if we were using the "non-fogging" technique or the "building-up" technique the lag of accommodation behind convergence would be immediately taken up by the plus power added before the eyes. This would give a band of fast with motion becoming faster and faster until the sufficient plus power acted upon the secondary negative relative accommodation and gave the same with motion. Notice that from youth to about 60 years of age the high and low points approach each other. As previously stated, this is due to the fact that the lag curve consumes the total negative relative accommodation. Thus, I believe, we have explained one of the three factors at the near point which contributed to the value of the lens found under the dynamic test. This 1.50 D. allowance from the dynamic findings was understood and practiced by the late Dr. Bestor; but, it was found and carefully studied clinically by Dr. E. F. Tait that in some cases the allowance from the findings dynamically was more than 1.50. Let us consider another factor at the near point.

Discounting normal ciliary tonicity which is present at both distance and near, and is therefore a constant; also, not considering ciliary hypertonicity until a later paragraph, let us take a perfectly normal hypothetical case of an emmetrope between the ages of 10 and 40 years of age. This person refractively is a hyperope of between 1.25 D. at 10 years of age to 0.25 D. at 40 years of age and whose normal ciliary tonicity furnishes enough plus power in the crystalline lens to make him a practical emmetrope. Let us make a few tests on this patient.

Assume, for simplicity, a muscular condition of orthophoria for distance and a normal exophoria of from $4^{\Delta}$ to $6^{\Delta}$ at 13 inches. Now the total convergence from parallelism to 13 inches (in a 60 mm. P. D.) is just $18^{\Delta}$ ($9^{\Delta}$ in each eye). Of this $18^{\Delta}$ required for single binocular fixation at 13 inches only from $14^{\Delta}$ to $12^{\Delta}$ have been supplied by accommodation through the accommodative-convergent reflex. "This lack of convergence at the near point as compared to dis-

tance" is called the physiologic exophoria or P. E. This definition must be both memorized and then understood. In our hypothetical case the P. E. is between 4Δ an 6Δ. According to the authorities on this subject, two of them are Maddox and Tait, this is a normal amount of exophoria for 13 inches. Obviously, the fusional convergence makes up for this deficiency or lack of convergence at the near point. We now can readily see why the P. E. is incorrectly said to be equal to the fusional convergence at the near point. This unique condition is only true in one instance; that of orthophoria for distance. In all conditions of muscular balance the correct definition as given before, holds good for the P. E. For example, a case of 2Δ esophoria for distance and 4Δ exophoria for near has a P. E. of 6Δ. Is not 4Δ of exo. a "lack of convergence of 6Δ as compared to the distance" which is 2Δ eso.? If the condition at the near point is the same as for distance, we have Physiologic Orthophoria. Also if we have more esophoria for near or less exophoria for near "as compared to distance" we have Physiologic Esophoria. These conditions, if found, are not ideal and not until we find 4Δ or 6Δ of P. E. with preferably orthophoria for distance, do we have an ideal case. If a patient comes to you with above 7Δ of Physiologic Esophoria, we must suspect pathology manifesting itself in the form of greatly exaggerated nervous reflexes. Let us consider again our hypothetical case.

When we take this same pair of emmetropic eyes and put them behind a refractor with a fogging lens before them, such as + 2.50 D. sph. O. U., and then require this patient to converge to 13 inches on a well-illuminated chart on our dynamic scope, the only accommodation in the eyes is that due to convergence-accommodation, and in this case the dioptric value of this factor is 1.50 D. (Remember we have disregarded ciliary tonicity and ciliary hypertoncity.) That the value of this convergence-accommodation is 1.50 D. may be shown as follows: Have this same patient fix attentively on a vertical line of fine type at 13 inches and add plus lenses equally in O. U. until the print starts to blur. We will find this value to be 1.50 D. of plus power before the eyes. Now, add base-in prisms before O. U. a little at a time and we will find we are able to add more plus power before the eyes until the print starts to blur again. When we have 9Δ base-in over each eye or a total of 18Δ base-in for O. U., we will be able to place before those eyes + 3.00 D. instead of + 1.50 D. as was found without the application of the prisms base-in. This adding of additional plus power before the eyes was due to a relaxation or a dropping off of accommodation in the eyes through the inhibiting of convergence and therefore, the convergence-accommodation. Now if no plus power were supplied within an emmetropic eye, a + 3.00 D. sph. must be added before the eye to cause the retina to be conjugate to a plane 13 inches from the eye. Thus, when operating the fogging technique in dynamic skiametry and finding the high point for 13 inches, three dioptres of plus power

must be found before the eyes, in the eyes, or divided in any proportion between these two places. Now, if a normal emmetropic eye furnishes 1.50 D. of plus power in the eye, due to convergence-accommodation, then the lens found before the eye will be + 1.50 D. sph. We could also explain this + 1.50 D. sph, before the eye as being the First Major factor at the near point, whereby we always find at least 1.50 D. more dynamically than is the true refraction. Remember, this has been a normal case. Subtract a 1.50 D. sph. from the + 1.50 D. sph. found under the dynamic test, and the result is 0.00 D. In other words, this patient is an emmetrope and the "True Refraction" is 0.00 D. sph. Now in dealing with practical emmetropes, we do not always find + 1.50 D. sph. under the dynamic test.

The highest value of the lens that may be found before emmetropic eyes under the test at 13 inches is + 3.00 D. sph. This would mean that no convergence-accommodation whatever had been supplied in the eyes upon convergence to 13 inches. Thus, our dynamic findings may vary between + 1.50 and + 3.00 D., all depending upon how much convergence-accommodation (varying from 1.50 D. to 0.00 D.) had been supplied.

We will now assume we have a patient who is an emmetrope with orthophoria for distance and 18 exophoria for 13 inches the P. E. (physiologic exophoria) is 18$^{\Delta}$. How much convergence-accommodation is stirred up by fixation at 13 inches? None, whatever, for in the reversing of the reflex arc no accommodative-convergence is present; therefore, the opposite or convergence-accommodation response is lacking. This particualr emmetrope when fixing at 13 inches is compelled to employ not the usual 1.50 D. of retinal accommodation (where convergence-accommodation is supplying 1.50 D.); but, he must bring forth 3.00 D. of retinal accommodation in order to see clearly at the near point. Under a dynamic fogging technique, + 3.00 D. sph, would be found before such eyes. How were these findings correlated?

Having these thoughts in mind, and having refracted or had charge of the refracting of many patients who were still fogged for months where only the usual 1.50 D. sph. had been subtracted from their dynamic findings, Dr. E. F. Tait in 1923 conceived the idea of a variable allowance in the dynamic findings for 13 inches of from 1.50 D. (as suggested by the late Dr. Bestor) to 3.00 D. and any intermediate value as worked out by Dr. Tait. The following table was devised by Dr. E. F. Tait to show this allowance which the writer of this paper has modified slightly in order to simplify it for teaching purposes:

| Accommodative-convergence | Convergent-accommodation | First Major Factor at the Near Point | Convergent-accommodation Deficiency or Second Major Factor | Total Allowance or Third Major Factor | P. E. |
|---|---|---|---|---|---|
| 12Δ | 1.50 D. | 1.50 D. | 0.00 D. | 1.50 D. | 4Δ to 6Δ |
| 10Δ | 1.25 D. | 1.50 D. | 0.25 D. | 1.75 D. | 8Δ |
| 8Δ | 1.00 D. | 1.50 D. | 0.50 D. | 2.00 D. | 10Δ |
| 6Δ | 0.75 D. | 1.50 D. | 0.75 D. | 2.25 D. | 12Δ |
| 4Δ | 0.50 D. | 1.50 D. | 1.00 D. | 2.50 D. | 14Δ |
| 2Δ | 0.25 D. | 1.50 D. | 1.25 D. | 2.75 D. | 16Δ |
| 0Δ | 0.00 D. | 1.50 D. | 1.50 D. | 3.00 D. | 18Δ |

The table is obtained by taking 12Δ of accommodative-convergence being stirred up by 1.50 of accommodation. By dividing 12Δ by 6Δ we have 2Δ, also 1.50 D. by 6 we have 0.25 D. Thus we have for every 2Δ of accommodative-convergence an equivalent of 0.25 D. of convergence-accommodation, all depending which is taken first, or, which is the controlling factor. Let us now apply the above table on our basic emmetrope.

If the P. E. is 10Δ this means that only 1.00 D. of convergence-accommodation was supplied in the eyes while convergence was maintained at 13 inches in the dynamic fogging technique. Therefore, we would obtain a + 2.00 D. sph. as our dynamic finding for O. U. (Notice the total dioptric values equals 3.00 D.) Previous to Dr. E. F. Tait's work in this line, only 1.50 D. would have been subtracted from the + 2.00 D. sph. found and the patient would then have been considered as being a 0.50 D. hyperope instead of our emmetrope. Is it any wonder that under the former techniques and faulty interpretation of the dynamic findings that refractionists found that the patients could not wear the dynamic findings? But, by applying the Tait System of Dynamic the "True Rx." is found regardless of a variable musculo-refractive reflex. The writer has attempted to show thus far:

1. Why at least 1.50 D. must be subtracted from the Dynamic findings.

2. Why this allowance varies from 1.50 D. to 3.00 D.

The second factor in a few words is just this: if the normal 1.50 D. of convergence-accommodation or any amount less down to 0.00 D. is supplied in the eye, our dynamic findings before the eyes will be from 1.50 D. to 3.00 D. too high and by applying Tait's P. E. and allowance table, this proper allowance is known. A good name for the plus lens manifesting itself before the eyes due to this factor is "the convergence-accommodation deficiency" for whenever there is a deficiency in the convergence-accommodation, taking 1.50 D. as a standard, it immediately raises our dynamic findings by that amount of the deficiency. This value we may quite accurately ascertain from the P. E. Let us now turn to the Third Major Factor at the near point.

This factor is the "True Ammetropia" and is obtained by subtracting the first two factors expressed in dioptres from the dioptric value of our dynamic findings. In other words we find two of three unknown factors and that which remains is the value of the third factor. It needs no explanation to show that 2.00 D. of hyperopia will cause an additional + 2.00 D. to be found dynamically or a 1.00 D. myope will cut down our dynamic findings by — 1.00 D. After we consider a very important procedure in the dynamic technique, we shall illustrate the three major factors with several examples.

Just as soon as we have our dynamic findings for O. U., we subtract the 1.50 D. of plus power that was an inherent property of our technique (fogging). The dynamic findings minus this 1.50 D. is known as "The Approximate Rx." It is with this correction that we ascertain the P. E. by making a tonicity test for distance and near. Right at this point is where the writer has seen errors made in clinical procedure that have interfered with a proper interpretation of the dynamic and muscular data. A technique of taking these tonicities that has been proven by practice to be very satisfactory is as follows: For distance a large letter "E" (20-200) is used as an object. About 6$^{\Delta}$ base-down over the O. D., using the Risley prism and naturally the upper image belongs to the O. D. If the diplopia is homonymous, the condition is one of esophoria, and the insertion of prism power base-out over the O.S. until the "E's" are in vertical alignment is the measure of this esophoria for distance. Similarly, exophoria is measured by prism power base-in in the case of heteronymous diplopia. Now, in finding the power of the prism over O.S. (either base-in or base-out) that causes vertical alignment, we must insert a large amount of prism power first base-out or base-in and throw the two images far apart horizontally. Then by reduction of this power we finally arrive at the proper prism value. This same process is repeated with a large amount of prism power inserted in the opposite direction (either base-in or base-out) and the power again reduced until vertical alignment is again obtained. By averaging these two results, found by bringing the images over each other from different sides of the patient, we have as accurate a subjective muscle tonicity test as is possible. This same method is applied to the near fixation object. At this test, however, a small arrow pointing upward about 8 mm. in height with one or two small letters on each side furnishes a good near point test object. In taking the near point tonicity, the patient must be under the test for at least one minute. This allows the eyes to assume a position of balance that is fairly constant. For example, if the test is made in a few seconds, it may be found that the patient has 3$^{\Delta}$ exophoria; however, if the prism over O.S. is increased to a large amount of base-out or base-in as explained above, and at least one minute is

consumed in taking the test, we may find that the eyes have now settled down to a condition of perhaps 8Δ exophoria. This last reading is the one used in finding the P. E., for we now have imitated the dynamic test where we called upon the eyes to converge to 13 inches for at least two or three minutes with a certain amount of convergence-accommodation affecting the power of the lens before the eye, by a value being assumed for the convergence-accommodation deficiency. Thus, when we reverse the process and ask accommodation to stir up so much convergence, we must let this reflex arc settle away to as constant a value as possible. In other words, we must make sure that the tonicities we take are the true ones and not a temporary affair that only holds good for a few brief seconds. The necessity for the actual tonicities is seen when we consider that the P. E. is calculated directly from these results. How the P. E. is found from the tonicities has already been explained. Let us make use of the P. E. and refer to our table.

If the P. E. should come out to be between 4Δ and 6Δ of exophoria, this shows us that an allowance of only 1.50 D. is correct as the Second Major Factor or the convergence-accommodation deficiency is 0.00 D. and no higher plus power was obtained before the eyes during the test except the usual 1.50 D. due to our technique operating on the First Major Factor. On the other hand, if the P. E. were found to be 8Δ exophoria, the allowance is 1.75 D. of which 1.50 D. is the usual 1.50 D. and 0.25 D. of convergence-accommodation deficiency. And so on up to a P. E. of 18Δ where the allowance is 3.00 D. Now you might ask, "What if the P. E. were not 4Δ or 6Δ of exophoria but physiologic orthophoria or even physiologic esophoria of 2Δ, 3Δ or 4Δ? What allowance would be made under these conditions?" Only the 1.50 D. allowance due to our First Factor at the near point. But, you say, why not less than 1.50 D. in this particular case? The reason is that, the normal 1.50 D. of convergence-accommodation in the eye during the dynamic test is not increased by a supernormal innervation from the convergence-accommodation reflex arc: for, 1.50 D. appears to be the peak of motor response by the lense and associated structures. Thus, if twice as much innervation through excessive convergence-accommodative reflex stimulation (physiologic esophoria) were received by the ciliary body, only 1.50 D. would result within the eye for this is the limit or peak of operation for convergence to 13 inches. We find a condition such as this not only in the ocular reflexes but in the physical world as well. For example, a power tube used as an amplifier in radio circuits will have a definite peak of operation beyond which we cannot go except by the altering of the tube characteristics. We may operate this tube under full load and obtain a fixed output in amplification for a definite input and any increase in the input side will only "block" the tube and result in a distorted but equal output. In patients found in practice, a condition of physiological esophoria may be only a temporary condition.

This physiological esophoria may return to normalcy through the removal of the cause (toxic, psychic) or in a refractive case, the application of the "True Rx." or still; a setting-in of fatigue exophoria resulting in physiological orthophoria and finally a high physiological exophoria may be the outcome. In the latter case, there develops a high resistance between the synaptical connections in the brain stem so that a normal amount of innervation from the accommodative side of the reflex will result in a very feeble convergent response. Thus, this person has a very high "lack of convergence at the near point as compared to distance" (high physiological exophoria). How to handle this rather common type of case will be discussed later. I will now present several cases illustrating the points covered so far in this paper:

CASE 1. Dyn. O. U. + 5.00 D. sph.
Tonicity (with appx. Rx., 1.50 subtracted from Dyn.)
4$^{\Delta}$ eso for distance.
6$^{\Delta}$ exo for 13 inches. P. E. 10$^{\Delta}$; allowance 2.00 D.
"True Rx." O.U. + 3.00 D. sph.

CASE 2. Dyn. O.U. — 1.00 D. sph.
Tonicity (with appx. Rx.)
1$^{\Delta}$ exo for distance.
7$^{\Delta}$ exo for distance. P. E. 6$^{\Delta}$; allowance 1.50 D.
"True Rx." O.U. — 2.50 D. sph.

Thus far we have considered only cases without the presence of "ciliary hypertonicity" or "cramp." From clinical data we conclude that *most* patients have some "ciliary hypertonicity" varying from 0.25 D. to 0.75 D. as the most common and from 0.75 D. to 1.50 D. as rare. Therefore, when our "True Rx." is finally ascertained from the dynamic musculo-refractive data, we find that this correction rarely fogs the patient more than 20/30 O. U. This indistinct vision for distance is soon mitigated and results in normal V. A. either under or without treatment. Naturally, under the proper treatment the progress is considerably faster than without treatment. It is in the finding of the "True Rx." in these cases between 10 and 40 years of age that the Practical Tait Dynamic System proves its worth. The probability of a "cramp" after the age of 40 is quite small. However, this dynamic system may be interpreted with an accuracy that is not quite as great as that between 10 and 40 years of age; but, is nevertheless qualitative enough to be of value. Generally, at this age where we are sure no "cramp" is carried over into the presbyopic age, we may use the Sheard non-fogging or building up system and thereby determine objectively the proper add for the near point. In the Tait dynamic system, let us consider an explanation as to just how all possible "cramp" cases with variable amounts of convergent-accommodation as measured by the P. E. (See Table) are made manifest by a comparison of the "True Rx." and the static or subjective correction.

For the explanations which are to follow, the writer is indebted to the author of this dynamic system, Dr. E. F. Tait of The Pennsylvania State College of Optometry, through his courses in Theoretical and Practical Optometry. Also to Sydney W. Smith, '30, an undergraduate at the above college who has served as a most valuable assistant in securing clinical data and through his realization by actual demonstration of the practicability of The Tait Dynamic System, which has aided the writer in searching for further possible explanations and a mathematical formula whereby we may assign definite values to the Second Major Factor at the Near Point which is the big variable in this particular technique. Acknowledgment is also given to Henry M. Schneider, '29, for a certain example which will be mentioned again in this discourse.

All our attention is now to be focused upon the behavior of the Second Major Factor at the Near Point and its variances under the existence of "ciliary hypertonicity" and variable convergence- accommodation. For, at any age between 10 and 40 years the First Major Factor at the Near Point is a constant of 1.50 D. of excess plus power found before the eyes in our dynamic findings as a result of the fogging technique. Likewise, the Third Major Factor at the Near Point (True Ammetropia) is most certainly a constant at any particular time. Therefore, let us now together consider more fully this important variable Second Major Factor.

Dynamic skiametry has been termed as such by various writers, their principal idea being "the accommodative power of the eye is in force at a fixed near point." In the Tait dynamic system the main or important reason the word "dynamic" is prefixed is due to accommodation of a specific type, namely, convergence-accommodation. The presence of this convergence-accommodation is the *sine qua non*—all important factor whereby a difference between the "True Rx." and static or subjective correction may be obtained. It must be remembered that where the "True Rx." is higher in plus value or lower in minus value than the static or subjective correction, the existence of a "cramp" is proven. How does the presence of "cramp" or "ciliary hypertonicity" affect the subjective and static findings?

When any pair of eyes, whose muscular balance is one of orthophoria for distance, are refracted statically or subjectively (these two tests should agree very closely) the lens obtained before these eyes consists of the following factors: basic ammetropia (determined by the curvature and index of the media and the anterior-posterior length of the eyeball), minus the dioptric value of the normal ciliary tonicity (a practical emmetrope is a basic hyperope of from 1.25 D. to 0.25D., depending upon the age), minus the dioptric value of the "ciliary hypertonicity" (latent hyperopia or functional myopia depending upon what ammetropia we find associated with the "ciliary hypertonicity"). It is not necessary in this discourse to discuss the origin of "ciliary hypertonicity" except that, over use of the ciliary

muscle, especially rapid changes in the contracture of this muscle necessitated by rapid accommodation for each end of the interval of Strum in those cases of corneal astigmia, will result in an additional innervation, hypertonic in character, from the proprioceptive nervous system. Thus, the muscle cannot relax to its normal tonic condition. This results in additional plus power being supplied by the crystalline lens which in turn lowers any lens value found before the eyes in the static or subjective tests. These are the conditions as we find them in the above tests. Now, let us turn to the Second Major Factor at the Near Point and determine how it behaves during the Tait Dynamic test.

In our freshmen year in college we were given this statement by the author of this system: "The cramp is included at the near point." What does this mean to you and to me? Upon this one statement the writer has constructed a possible working theory for the truth of the above statement. Doubtless, there are other possible reasons for this statement but they all will be but modifications of the reasons which are to follow.

If we admit that "the cramp is included at the near point" (and we are compelled to do this for clinical data shows the "True Rx." and the static or subjective correction to be different in certain cases), we must ask, "What includes the cramp?" Most certainly the convergence-accommodation includes the "cramp" for this is the only major factor within the eye which is not present for distance but which is in play during the fogging technique with convergence to 13 inches. Could, by the Laws of Conservation of Mass and Energy and the existence of an equal and opposite reaction for every action, this convergence-accommodation be not affected or altered in performing the work of including the existing cramp? Certainly not. If the convergence-accommodation includes the cramp, it itself must pay for having done this work.

I have previously stated that the convergence-accommodation for 13 inches convergence distance did not exceed 1.50 D. as a limit. When we consider a case of normal P. E. where just 1.50 D. of convergence-accommodation is stirred up, when the eyes are directed to converge to one of the charts on our dynamic scope (See table); and in addition, assume this case to possess a 1.00 D. ciliary cramp, we might hastily conclude that 1.50 D. plus 1.00 D. or 2.50 D. of accommodation are supplied within the eyes during the dynamic test. Again, not by theory but by careful consideration of thousands of clinical cases, we are forced to admit that our hasty conclusion is most surely wrong. For from this mass of data we find that the actual accommodation within those eyes has been 1.50 D., just as we would have assumed from the normal P. E. (See table). At this time we will employ an example of Henry M. Schneider, '29, to illustrate this point.

Hold your arm down at the side of the body. Assume this position to represent normal ciliary tonicity as the muscles of your

arm have only a normal tonicity (provided your arm is not "overtrained"). Now, bend the arm at the elbow and touch the mouth. When the arm is in this position assume that 1.50 D. are in force (provided, of course, the ciliary muscle and associated structures were in use). Then, either assume or develop a hypertonicity of the arm muscles and now the arm will not relax to the side but instead remains two-thirds bent or opposite the chest. This condition represents ciliary hypertonicity of say 1.00 D. Now, attempt to touch the mouth again as before. You will find that the hand will stop at the mouth and not fly past behind the head (representing 2.50 D. of accommodation). In other words, even though a hypertonicity is present, the hand only is raised to the mouth (representing 1.50 D. of accommodation). This is what is meant by the statement, "the cramp is included at the near point": is not the hypertonicity in the arm muscles included in the further contraction to the mouth (0.50 D.)? Is it clear now that in a pair of eyes having a "cramp" of 1.00 D. the normal convergence-accommodation of 1.50 D. only supplies 0.50 D. more or 1.00 D. plus 0.50 D. total of 1.50 D.? The other 1.00 D. of the convergence-accommodation is employed in including the "cramp." We are now ready to present a working formula for the Second Major Factor at the Near Point.

Convergence-accommodation deficiency, MINUS, cramp. Putting the above formula in abbreviated form we had: (C. A. def.—Cramp).

The first part of this formula needs no explanation; we all understand how a deficiency in the amount of the convergence-accommodation within the eyes will raise the lens value before the eyes found dynamically and this to the extent of the deficiency. However, we must further see that if the convergence-accommodation includes the cramp, an inefficiency in the convergence-accommodation equal to the amount of the cramp is produced. The end result is still a deficiency in the convergence-accommodation even though a normal amount was originally supplied as shown by the normal P. E. Thus, it makes no difference whether the convergence-accommodation is not supplied normally in the convergence-accommodative reflex, or whether this reflex is normal and some of this convergence-accommodation is employed in "including the cramp." A deficiency results which raises the dynamic findings and since there is no convergence-accommodation during the static or subjective tests, the unincluded cramp does not manifest itself as in the dynamic test. Therefore, by a comparison between the "True Rx." and the static or subjective corrections the existance of a "cramp" is ascertained. To illustrate more fully how the "cramp" affects the dynamic findings, let us consider a very simple example.

Lay three (3) half dollar silver coins on the table and call each one 0.50 D. of convergence-accommodation. This is a normal case, is it not? (See table). Now assume that two of these were employed in including an existing "cramp" within the eyes. Take

these two coins away and the deficiency is now 1.00 D. Furthermore, the deficiency was equal to the "cramp" in this case as no other factor was present to affect the value of the deficiency (the "cramp" being the only one). Now assume a P. E. of 10$^{\Delta}$. Here by consulting the table we see that only 1.00 D. of convergence-accommodation is supplied in the eyes. Place on the table only two half dollars. Our deficiency is now 0.50 D. In addition assume a "cramp" of 1.00 D. in this pair of eyes. Here all of the convergence-accommodation is employed in including the "cramp." (Take away the remaining two coins.) Thus, the deficiency is 1.50 D. for what convergence-accommodation was present was all employed in including the "cramp." As far as the dynamic test is concerned, we might just as well had a case of a P. E. of 18$^{\Delta}$ and no "cramp" as the convergence-accommodative deficiency is 1.50 D. in either case. We shall consider briefly the second part of the mathematical working formula, dealing with the minus "cramp."

In the static, subjective or dynamic test, the "cramp" represents positive accommodation within the eye and therefore lowers the plus value or increases the minus value of that lens before the eyes. Thus, in order to show this fact in any formula a minus value must be assigned to any existing "cramp." The complete formula is then, convergence-accommodation deficiency, minus "cramp" or (CA def.—Cramp). Notice in the dynamic test that if there is enough convergence-accommodation present to include the "cramp," the convergence-accommodation deficiency will be of the same value as the "cramp" but of the opposite sign. Furthermore, any convergence-accommodation deficiency in addition to that caused by the "cramp," as in a case of higher P. E. than normal (See table) which means that a lack of normal convergence-accommodation though the convergence-accommodative reflex was present, will raise the convergence-accommodation deficiency by the amount of that deficiency. All this may be expressed by the following statement: if the "cramp" does not exceed the convergence-accommodation in amount, the Second Major Factor at the Near Point has that value in dioptres according to the P. E. in that case. Reconsider the last sentence until you understand it perfectly for it will clarify the work which is to follow. This is a rather complicated point in the explanation to understand and we will further illustrate it by several examples. Since, for any particular case at a given time, the First and Third Major Factors are constants, we will deal only with the Second Major Factor which is the big variable.

CASE 1.

Given:

P. E. 6$^{\Delta}$
"Cramp" 1.00 D.

Working formula:
Second Major Factor at Near Point:

C.A. def.—"Cramp"
+ 1.00 D. — 1.00 D. = 0.00 D.

Explanation:

The only convergence-accommodation deficiency is that caused by the act of including the "cramp" of 1.00 D. for the P. E. is normal and a normal 1.50 D. of convergence-accommodation was probably stirred up within the eyes during this dynamic test. Notice also, we assign zero (0) as a result of our calculations for the Second Major Factor at the Near Point from the taking of the P. E. This point is very important: we clinically ascertain the value of the Second Major Factor at the Near Point from the P. E. and hope that all of the "cramp" was included during the dynamic test. In those cases where all of the "cramp" is not included, an error in the "True Rx." is obtained equal to the amount of the "cramp" not included. This phase will be discussed a little later.

CASE 2.

Given:

Working formula:
Second Major Factor at Near Point:

P. E. 8Δ

"Cramp" 1.00 D.

C.A. def.—"Cramp"
+ 1.25 D. — 1.00 D. = + 0.25 D.

Explanation:

Since the P. E. is 8Δ, we assume that only 1.25 D. of convergence-accommodation had been supplied in the eyes. The deficiency is already 0.25 D. (with 1.50 D. as a standard for C.A.). In addition to this slight deficiency there is created a deficiency of 1.00 D. due to the including of the "cramp" by the convergence-accommodation. Therefore the total deficiency is 0.25 D. + 1.00 D. = 1.25 D. Note again that here the value of the Second Major Factor is 0.25 D. just as expected from the P. E. of 8Δ. One more case will be the limit with a "cramp" of 1.00 D. as in the next case the convergence-accommodation just includes the "cramp" for they are both equal to 1.00 D.

CASE 3.

Given:

Working formula:
Second Major Factor at Near Point:

P. E. 10Δ
"Cramp" 1.00 D.

C.A. def.—"Cramp"
+ 1.50 D. — 1.00 D. = + 0.50 D.

Explanation:

Here the convergence-accommodation deficiency right from the start is 0.50 D. as with the P. E. of 10Δ only 1.00 D. was stirred up within the eyes. Also, all the convergence-accommodation (1.00 D.) is employed in including the 1.00 D. "cramp." Therefore the C. A. def. is 1.50 D. Again the value of the Second Major Factor at the Near Point is as we expected through the taking of the P. E.

Let me repeat: The value of the Second Major Factor at the Near Point during the dynamic test (the variable in any particular case) is properly ascertained by the taking of the P. E. This is true in the great majority of the cases where all of the "cramp" is included by the convergence-accommodation. If all of the "cramp" is not included the "True Rx." is wrong by the amount of the "cramp" not included. The numerical reason for this is that the dioptric value of the Second Major Factor at the Near Point will be actually lower than the calculated value from the taking of the P. E. Let us take one of those cases.

CASE 4.

Given:

P. E. 14Δ
"Cramp" 1.00 D.

Working formula:
C.A. def.—"Cramp"
+ 1.50 D. — 1.00 D. = + 0.50 D.

Explanation:

How much wrong is the "True Rx."? The answer to this question may be found by realizing that the convergence-accommodation is only 0.50 D. (P. E. of 14Δ), so therefore, this accommodation could only include one-half of the "cramp." Thus, the half of the "cramp" which is not included will subtract from the dynamic findings. The "True Rx." is then too low a plus value or too high a minus value to the extent of the "cramp" not included. In the above case the "True Rx." is 0.50 D. wrong. This fact may also be shown by considering the data as given in this case as it affects the working formula.

Due to the P. E. of 14Δ the convergence-accommodation deficiency, as caused by a lack of reflex stimulation, is 1.00 D. (See table). Also, what convergence-accommodation (0.50 D.) has been stirred up during the dynamic test is all employed in trying to include the existing "cramp." Thus, the total or final deficiency is 1.50 D. What little convergence-accommodation is produced is used up so that the deficiency is the same as a case with P. E. 18Δ (no convergence-accommodation) and no "cramp." However, when we took the P. E. on Case 4, we have assumed that the Second Major Factor at the Near Point was + 1.00 D. of lens value which was the manifestation of a pure deficiency in convergence-accommodation. Remember we do not know clinically whether a "cramp" exists or the amount of same until a final comparison of the "True Rx." and the static or subjective correction. Therefore we subtract or reduce in plus value (raise in minus value) the approximate correction according to the P. E. In the average case where all of the "cramp" is included by the convergence-accommodation, the true value of the Second Major Factor at the Near Point and the calculated value from the P. E. are equal. In other words, that value which we deduct from the approxi-

mate correction is the proper value and the "True Rx." is correct. In the above case, No. 4, the true value of the Second Major Factor at the Near Point is + 0.50 D. Notice the calculation from the working formula for this value. But, we from the P. E. assume that this value is + 1.00 D. (see table) and therefore we deduct 1.00 D. instead of 0.50 D. with the result that the "True Rx." is 0.50 D. incorrect. Notice, please, this value is exactly that which we theoretically would expect and mathematically do find by the application of the working formula.

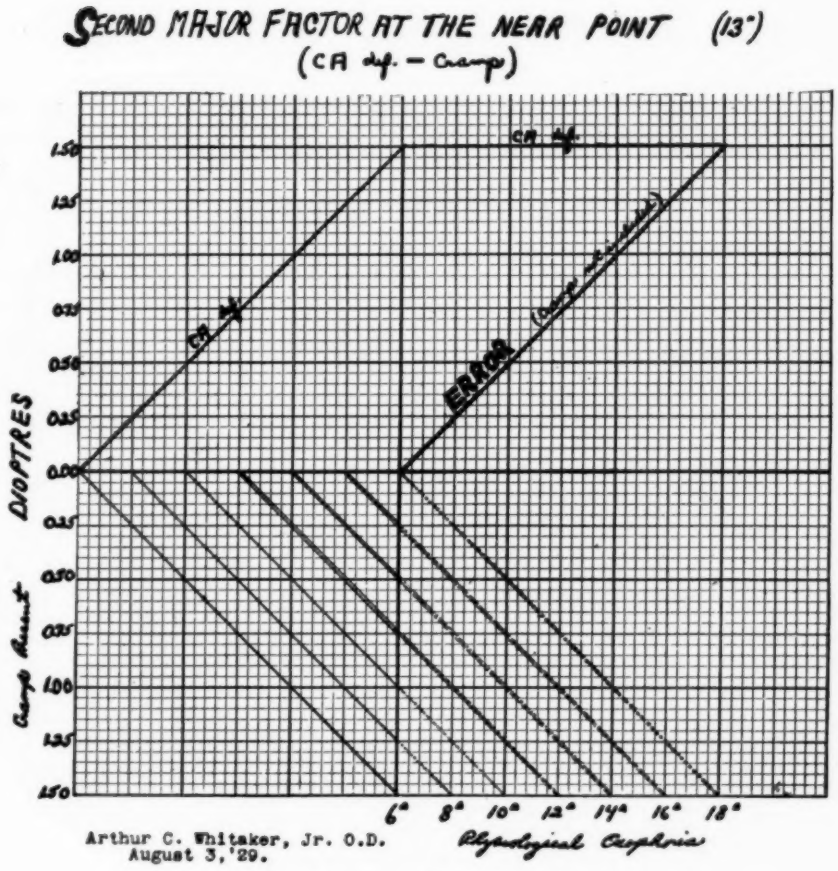
From thousands of clinical cases and over 250 cases that the writer personally refracted by means of the Tait Dynamic System, it is quite well certain that the average "cramp" does not exceed 0.75 D. Thus, up to a P. E. of 12$^{\Delta}$ where the convergence-accommodation would be 0.75 D. and just be able to include this "cramp," we can operate the dynamic test at 13 inches and be satisfied that the correction found is in truth the "True Rx." If the P. E. is 14$^{\Delta}$ we may stir up 1.00 D. of convergence-accommodation by moving in to 8 inches where the approximate correction becomes 2.00 D. from the dynamic findings and 0.50 D. is further deducted from this correction, for every two prism dioptres above six. The muscle data for the P. E. is still made at 13 inches but the different allowances make up for the change in the working distance.

In these last paragraphs the writer has attempted to show the limitations of the Tait Dynamic System from a purely refractive standpoint. The convergence-accommodation is the vital factor and if this falls below 0.75 D. (P. E. of higher than 12$^{\Delta}$) the possibility of including the average "cramp" is very slim. Nevertheless, we are able to recognize such a case as one requiring treatment to regain a normal convergence-accommodation reflex by the removal of all possibilities of focal infection, fatigue of the reflex arcs through overuse wherein the treatment is inhibition of accommodation through fogging lenses and lessening of convergence through the application of base-in prisms.

Now, instead of calculating the values for the Second Major Factor from the formula, we may have each of the separate values by consulting the graph for this important factor. Let us consider this graph (Number 2).

On the left we have dioptres. From the heavy horizontal line (zero line) upwards we have dioptres for both C. A. def. and also error (Cramp not included). From the horizontal line downwards we have dioptres for the amount of Cramp present. From the heavy vertical line to the right, we have P. E. from 6$^{\Delta}$ to 18$^{\Delta}$. These factors are the variables in the Second Major Factor. Let us consider a few examples.

Take a P. E. of 6$^{\Delta}$ and a Cramp of 1.00 D. Go down the line marked 6$^{\Delta}$ to 1.00 D. on the graph. This is four lines below the horizontal. Now follow vertically up till where the C. A. def. crosses this line and we find that the value is 1.00 D. Substitute these two




Graph Number 2.

values in the formula, (CA def.—Cramp) or (+ 1.00 — 1.00 D.) 0.00. Is not the numerical value of this factor 0.00 when the P. E. is 6Δ and all of the Cramp is included by sufficient convergent-accommodations? Follow the Error line down to where the 6Δ line cuts the horizontal and we find that the Error is 0.00. This is what we would expect as all the Cramp is included. To further illustrate I will use Case 4 of a few pages back to show how the values of the Second Major Factor can be obtained immediately from the graph.

The P. E. in this case is 14Δ. Follow upward and to the left on the line marked 14Δ. Stop opposite 1.00 D. of Cramp present which is four lines down from the horizontal. Go straight up this line to the line marked C.A. def. and read the value as 1.50 D. Substitute the values in the working formula and we have (+ 1.50 — 1.00) + 0.50. But, we by taking the P. E. in this case have calculated that the value of the Second Major Factor is 1.00 (See Table).

Thus, not knowing the amount of the Cramp present we subtract 1.00 D. from the approximate correction instead of 0.50 D. and we have an error of 0.50. This can be verified by going straight upward on the line where the P. E. of 14Δ cuts the horizontal line for 1.00 D. of Cramp present. This will be found to be the 0.50 D. as expected. Therefore, we have a graphic representation of all the variables in the Second Major Factor.

In the previous paragraph the writer has discussed the Three Major Factors at the Near Point and has attempted to show through a "Working Formula," with explanations, a possible manner in which the "True Rx." is ascertained and also how an existing "cramp" may or may not be all included in the dynamic findings. The reader will recall that the all-important requisite is convergence-accommodation to include and thus manifest the "cramp" by a comparison of the "True Rx." and the static or subjective refractions. Let us now consider other possibilities of the Tait Dynamic System.

One of the old questions in Optometry is to know just how much of the ophthalmometric findings to prescribe with any particular patient. We have wonderfully accurate makes of ophthalmometers whereby we may read the axis and amount of the astigmia as it exists on the cornea. However, no one is so foolish as to prescribe these findings without much further judgment. In the first place, that cylindrical lens power which is placed 13 or 15 mm. from the cornea and is equivalent to the actual corneal astigmia may be found accurately for all practical purposes by employing this table:

Up to 2.00 D. reduce by 0.25 D.

From 2.00 D. to 4.00 D. reduce by 0.50 D.

From 4.00 D. to 6.00 D. reduce by 0.75 D.

It makes no difference whether the astigmia is "with" or "against" the rules provided not above 2.00 D. for against as we are using a "plus dominancy" and the power of the cylinder is merely increased in effectivity by the distance from the cornea it is placed How much of the ophthalmometer findings reduced by the above table are we to prescribe?

From a comparison of hundreds of cases, we find that the cylinders as found dynamically will correspond or more nearly correspond to the modified opthalmometer findings than do those cylinders found statically or subjectively. For example:

Ophthalmometer O. U. 1.00 90/180.

"True Rx." O. U. + 2.00 D. sph. ⊃ — 0.75 cx. 180.

Static or subjective O. U. + 1.25 D. sph. ⊃ — 0.25 cx. 180.

Here a "cramp" of 0.75 D. exists along with 0.50 D. of "temporary" lenticular astigmia. Why "temporary"? Because under the dynamic test the convergence-accommodation has "ironed out" some of the lenticular astigmia which returned when making the static or subjective test. Optometrists will recall many cases, especially

in younger patients where the amount and axis of the manifest astigmia will change during the actual static or subjective tests. In this case we would prescribe the 0.75 D. cylinder, for in a short time, both the "cramp" and the "temporary" lenticular condition would relax and the "True Rx." would be perfectly acceptable. Another type of case is illustrated by the following:

Ophthalmometer O. U. 1.50 90/180.

"True Rx." O. U. + 1.00 D. sph. — 0.50 D. cx. 180.

Static or Sub. O. U. + 1.00 D. sph. — 0.50 D. cx. 180.

Here we have what is termed a "permanent" lenticular astigmia. Notice also, no ciliary "cramp" exists. This may or may not be the case with this particular type of astigmia but more often a "temporary" astigmia will accompany a "cramp" case. During the dynamic test, in the case of the "permanent" lenticular astigmia, no lenticular astigmia was "ironed out" by the convergence-accommodation and thus both the dynamic and static cylinders agree. In this case, we would be a little dubious about prescribing a full or nearly full ophthalmometer finding. Nevertheless, if the patient is under 35 years of age the possibility of correcting more of the astigmia is always present. In concluding this point remember that, if the astigmia is "temporary," prescribe a full or nearly full ophthalmometer modified cylinder especially in "cramp" cases under 35 years of age. If astigmia is shown to be "permanent" but patient is under 35 years of age, we may attempt cautiously to prescribe more cylinder than is manifested statically or subjectively. In low amounts of corneal astigmia, 0.25 D. to 0.75 D., it is sometimes found that the patient accepts according to the "True Rx." some or nearly all the proper ophthalmometric cylinders. But, statically or subjectively that same patient may require a small cylinder "against" the rule or opposite to the ophthalmometer findings. This case, the reader will recognize is one of "temporary" lenticular astigmia and should be corrected fully according to the ophthalmometer cylinders. Thus, the Tait Dynamic System not only gives us the "True Spherical Correction" but also the "True Cylindrical Correction."

The writer has in this paper attempted in as simplified a manner as possible to introduce for further practice and consideration a dynamic system as developed in a clinical background over a period of seven years at The Pennsylvania State College of Optometry at Philadelphia. The readers of this manuscript are no doubt familiar with many other systems that are classified as Dynamic Skiametry for all Optometric magazines at times publish such discussions. Every one of these other systems are but slight modifications of the old Sheard "non-fogging" method. For example: Some optometrists do a "non-fogging" (starting from the bottom and adding plus lenses) until the first fast-with-motion is obtained. Others will introduce base-in prisms during the test and find that a higher plus value for the dynamic is obtained. No one seems to know how

much allowance to make in this particular technique as the writer has heard of allowances of from 0.75 D. to 1.50 D. And to complicate matters one hundred and one explanations are given for this allowance from one hundred and one different users of this technique. Recently, Dr. Trelevan, of Columbia University in a talk on Dynamic Skiametry before the New Jersey Society of Optometrists explained a further modification of the "non-fogging" technique.

In brief his technique was as follows: "Non-fogging" with the insertion of plus lenses (and of course the proper plus cylinders if astigmia be present) until the first fast-with-motion was obtained by proceeding on until a high point of what he terms neutrality is obtained. (In reality this is almost the same point that would be obtained if a "fogging" technique were followed, for in one the operator comes up to the point and in the other the operator comes down to the point.) He further states that generally 1.50 D. must be subtracted from the dynamic findings (note this in the value in dioptres of the First Major Factor at the Near Point as concerned in the "fogging" technique) and that any reduction necessary as found statically or subjectively represents "latent hyperopia." The reader is now referred back to earlier portions of this discourse where this usual 1.50 D. allowance was observed and carefully noted by Tait. To briefly review, it was found that the big variable in any particular case between the ages of 10 and 40 years was the Second Major Factor at the Near Point and that this factor expressed in dioptres could be ascertained, provided all the "cramp" was included by the convergence-accommodation, through the taking of P. E. or muscle data for distance and near. Or in other words, a variable amount of convergence-accommodation is stirred up during the taking of the dynamic findings which would affect that lens value found during the test. These could be calculated and the proper allowances made for this variable by measuring the reverse process that of accommodative-convergence ($18^{\Delta}$ — P. E.). Thus in using the technique as advocated by Trelevan, it is possible in a case of no or very little convergence-accommodative reflexes (these cases are not infrequent) to make the absolutely false statement that this patient has about 1.50 D. of "latent hyperopia." For in this case he would make the usual allowance of 1.50 D. where a proper allowance of 3.00 D. should have been made from the dynamic findings. It was just such cases as the above that six or seven years ago prompted Tait to form a technique whereby all cases could properly be diagnosed as to "True Rx."

The Second Major Factor at the Near Point is almost never equal to zero; thus, any technique not considering this fact does not arrive at the "True Rx." Trelevan apparently does not consider this factor as he makes no attempt to calculate this variable from any source.

We fully realize that the Tait Dynamic System is not worked out and understood to the nth degree; yet, this system has been

carefully studied and given the "acid test" on a sufficient number of cases with the results warranting its use. The many Optometrists who have recently given this system a thorough investigation by learning the technique, building the proper dynamic scope, and exercising the necessary judgment for each particular case, have acclaimed it practical in every respect.

The bringing forth of this dynamic system by Dr. E. F. Tait is only one of the many ways in which such a research worker backed by the resources of a huge Optometrical Clinic handling thousands of patients yearly, is contributing to our profession.

It has indeed been a pleasure to aid in the collecting of clinical data at the college for this system and in a small way further introduce some of these findings with possible explanations for the benefit of those interested in "Practical Objective Refraction."

*Summary*

TECHNIQUE: Positive fixation by patient on well-illuminated chart located between 25 and 30 mm. from center of mirror. Fogging and reduction of plus power to the high point (first fast against). Insertion of C. C. cylinders with axis parallel to faster movement, until the primary and secondary meridians are of the same relative speed.

INTERPRETATION OF RESULTS: A subtraction of 1.50 D. from the dynamic findings giving the approximate correction. The taking of the tonicity for distance and near with this correction and an ascertaining of the P. E. (physiologic exophoria, "the lack of convergence at the near point as compared to distance"). For every 2$^{\Delta}$ above 6$^{\Delta}$ of P. E. a further subtraction of 0.25 D. from the approximate correction with the final result known as the "True Rx." If patient does not accept this high a plus or low a minus value, the refractive proof of a "cramp" is established. If the cylinders found dynamically, agree or more nearly agree with the ophthalmometer than those cylinders found statically or subjectively; then, the existence of a "temporary" lenticular condition is proven. If the Dynamic cylinders agree with the static and subjective cylinders, the lenticular condition is probably "permanent." However, if patient is under 35 years of age a part of the ophthalmometer findings may be accepted under treatment.

TREATMENT: Prescribe "True Rx." or a 0.25 D. reduction of same. If cramp is fairly high (1.00 to 1.50 D.), and patient's visual acuity must be good, reduce correction somewhat and prescribe 2$^{\Delta}$ base-in in O. U. for distance. This may be followed up by base-in prism exercise.

*Note:* The average "cramp" will fog the patient to only 20/30. If the association between accommodation and convergence is lost, as shown by the high P. E. (taken with the approximate correction), a "cramp" not included or disclosed may be present. In this case fog the patient 0.50 D. above the "True Rx." and add 2$^{\Delta}$ base-in

for distance. Also, segs. of + 1.00 D. with 3Δ base-in for O. U. If the progress of patient is good, this correction may be modified later by the removal of the prism plus segs. In cases of "Temporary" lenticular conditions, the ophthalmometer findings with the proper allowance may be prescribed with gratifying results.

In the "permanent" lenticular type of case, under the age of 35, not a small portion of the ophthalmometer findings may be gradually prescribed. After 35 years of age, the possibility of the above is practically impossible and better results are obtained if the static and subjective cylinders are given.

The existence of a high exophoria for near together with a vertical imbalance, both for distance and near, is often mitigated by the application of the "True Rx."

*Note:* No reference is made to any information obtained from a complete study of the muscle data.

PRESENT EXPLANATION FOR LENS VALUES AS FOUND DYNAMICALLY BY THIS SYSTEM: Due to the presence of sufficient plus power (fogging technique) a "total" negative relative accommodation manifests itself as 1.50 D. of plus power before the eye which has been designated, The First Major Factor at the Near Point. This 'total" negative relative accommodation consists of two divisions: (a) a lag of accommodation behind convergence whose value is 0.25 D. at 10 years of age and 1.25 D. at 40 years of age. (b) The rest of the 1.50 D. of "total" negative relative accommodation: *i. e.*, 1.25 D. at 10 years of age and 0.25 D. at 40 years of age is the result of inhibition by the sufficient plus present during the dynamic test. This acts upon the "retinal" accommodation within the eye. The only other accommodation present (except normal ciliary tonicity which is a constant for both distance and near and therefore does not alter a comparison between the dynamic and static results; also, ciliary hypertonicity or "cramp" which will be considered shortly) is convergence-accommodation.

The variable amount of convergence-accommodation which may be present under the dynamic test is responsible for the Second Major Factor at the Near Point. This is "convergence-accommodative deficiency" and manifests itself as plus lens power before the eye whenever, for any reason the normal amount of convergence-accommodation falls off within the eye. By previous methods not to be explained here in this summary, the normal amount of convergence-accommodation for 13 inches is 1.50 D. If the association between accommodation and convergence is such that not a normal amount of this type of accommodation is supplied (as shown by the amount of the accommodative-convergence through the ascertaining of the P. E.) then; this lack of "deficiency" will be found before the eye during the test. The variable allowance between 1.50 D. and 3.00 D. depending upon the P. E. takes care of this factor. How does a "cramp" case show up through the Tait Dynamic System by a

comparison between the "True Rx." and the Static or Subjective Correction?

The existence of a ciliary hypertonicity will reduce the static and subjective correction by the amount of the "cramp." This fact is too obvious to warrant further explanation. But, when we make a dynamic test we have in force a certain (known) amount of convergence-accommodation which by its presence includes the "cramp," provided of course the "cramp" does not exceed the amount of convergence-accommodation. Apparently, the "cramp" or ciliary hypertonicity increases the "convergence-accommodation deficiency" by the amount of the "cramp," for surely, if the convergence-accommodation includes the "cramp" it itself must pay for such an action. The result is a raising of the "Deficiency" of convergence-accommodation. Thus, provided there is enough convergence-accommodation within the eye during the dynamic test, a "cramp" will be disclosed by this system, when the dynamic findings are compared with the static or subjective findings.

The Third Major Factor at the Near Point: the ametropia, without explanation can be seen to affect the dynamic findings by the amount and the kind of the ametropia.

This is a brief, and in some ways, an incomplete discussion on the Tait Dynamic System as developed by Dr. Edwin F. Tait in the clinics of The Pennsylvania State College of Optometry. We, as graduates of that institution, are proud to have played even a small part in the successful application of this system in the well attended clinics of our Alma Mater.

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Reference: (1) The Journal, Vol. 1, April, 1929, No. 2. (Published quarterly by the New Jersey Optometric Association.)

# OCULAR ELECTROTHERAPY

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## CHAPTER IX.

## THE PHYSIOLOGICAL EFFECTS OF THERAPEUTIC CURRENTS

*Physiological Effects of Diathermia.* (Part II)

The application of diathermy has a profound effect upon the eye, its muscles, the nerves and the brain. In view of the fact that the modern refractionist is called upon now, more than ever before, to deal with the muscles and nerves of the eye and indirectly with the brain, we deem this subject of extreme importance which deserves special attention. We shall therefore go into some length in describing the physiology of these organs and the effect of the application of electricity upon them.

The brain is considered to be as a sensitive electrical condenser which is ready at any time to charge the nerves that they may set their appropriate muscles in action.

The effects of electricity upon the muscles and nerves were discovered by Professor Galvani of Bologna who accidentally happened to touch two different metals in contact to certain nerves and muscles of a lifeless frog. He was surprised to find that the frog's lifeless legs resumed all activity of their accustomed motions. After Galvani's death, Professor Adini, a nephew, traveled through Europe conducting some unique experiments in order to prove the truth of Galvani's statements and theories. Adini maintained that muscular contractions are excited by the development of electricity in the animal-machine which is conducted from the brain through nerves to the muscles, without the use of any electrical conductors. Also that all animals are endowed with an inherent electricity appropriate to their economy which is secreted by the brain and through the nerves is communicated to every part of the body.

*Nerve Stimulation.* In analyzing the effect of external stimulation of the nerve, the eminent psychologist Wundt[37] claims that electrical currents lend themselves best for this purpose by virtue of the ease with which they destroy the molecular equilibrium of the nerve elements and with the extreme accuracy their mode of application can be regulated. Whenever there is a change in the irritability of the nervous elements to which we applied artificial

stimulation, we may expect to produce a change in the phenomena exhibited by the muscle. That is if the irritability of the nerve is diminished the muscular contraction will be weaker.

*Conductivity of Nerve Stimuli.* The nerve cell and its processes, which are composed of highly specialized form of protoplasm, possess the capability of transferring impulses from point to point of their substance. These impulses are conveyed in one direction only under normal conditions from dendrite to axon through the cell. However, by applying an artificial stimulation to a nerve, it can be shown that the nerve can conduct an impulse in both directions. The nerve, in actual experience is never called upon to perform this dual function.

*Electrical Changes in the Nerve.* Lickley[38] finds that if two areas, on a perfectly normal nerve be connected to a galvanometer it will be found that no current will flow through the circuit, as long as the nerve is not stimulated. When an impulse traverses the nerve, definite electrical changes take place. The point which the impulse is passing at any particular time becomes electrically negative to any other point. This phenomenon is known as *the wave of negativity.* It always accompanies a nerve impulse, whether that impulse be a normal one or one due to artificial stimulation.

There are four classes of agents each of which will stimulate a nerve. They are: mechanical, chemical, thermal and electrical, and are known as "general stimuli." Any one of these agents are capable of arousing, not only nerves, but a great variety of forms of living matter, including the muscles and glands of the higher animals.

Any one of these "general stimuli" is effective only when its application is sudden. For instance, a slow change in temperature will not excite the nerve, or to increase the pressure very gradually will crush the nerve, but it will not excite it. This is also true in regards to electricity. The electric current must have a degree of suddenness in its change if it is to act as a stimulus to the nerve.

DuBois-Reymond[39], one of the pioneers in "Electrophysiology," discovered in 1845 two closely related laws of the electrical excitation of the nerve. The first one is that *the mere passage of a current through the nerve does not stimulate it; only changes in the electric current will act as stimuli.* The change may consist of an increase or decrease in the current. This law can be proven experimentally with the nerve muscle preparation. It will be noted that the muscle twitches when the current first passes through the nerve. The twitching takes place at the start of the current only and remains at rest during the passage of the current and it twitches again when the current is either stopped or suddenly decreased or increased in strength. The second law of DuBois-Reymond is that *the greater exciting effect of any change of current is the more sudden the change.*

Later investigations have not effected the validity of the first law, at least not as far as the nerve is concerned, but with the introduction of the Tesla and d'Arsonval currents, it has been found that there was need for some modification in the second law, because it was found that the very rapidly oscillating currents are effective as stimuli only to a certain degree and that this effectiveness does not increase indefinitely with the rapidity of oscillations. For instance, a current having 1,000,000 oscillations per second will excite the nerve, providing of course that the current is very intense. Beyond a certain point, the effectiveness of the oscillations decrease as their rate increases. This question is at present agitating the minds of the leading students of "electrophysiology" and is far from settled. The findings of one group seem to be in contradiction to the findings of the other.

*The Electrical Nature of a Nerve Impulse.* It is an established experimental fact that the nerve is excited by the starting or stopping of an electric current, and that the current enters the nerve at the positive pole, or *anode,* and leaves it at the negative pole or the *cathode.* When the current is started the excitation is found to occur at the cathode and when stopped at the anode, that is the nerve-impulse starts at the cathode when the circuit is closed and at the anode when the circuit is broken.

When an electric current is passed through a nerve, certain changes take place in the nerve, which alter the excitability and conductivity of the nerve. The lowering excitability at the anode during the passage of a current is also accompanied by the lowering of the conductivity of the nerve for nervous impulses.

In considering the passage of the electric current between the neurons and the muscles one must bear in mind that the neurons are not in direct physical contact with each other. Also that the lines of communication between the neurons and the muscles, etc., are broken up by synapses.

Sherrington[40] claims that a synapse may have special properties: "It might restrain diffusion, bank up osmotic pressure, restrict the movement of ions, accumulate electric charges, support a double electric layer, alter in shape and surface tension with changes in difference of potential, alter in difference of potential with changes in surface tension or in shape, or intervene as a membrane between dilute solutions of electrolytes of different concentration."

The synapse then may be considered as a highly adopted switch which at some times opens the circuit and at other times closes it, now diminishes the flow of the current, and now accelerates it.

As an electric current flows constantly from an area of higher potential to an area of lower potential, hence, the nerve cell—which is the electric battery of the human system—would be in constant action were it not for the intervention of the synaptic switch. This would result in the constant work of the nerve cell

which would become exhausted just as an electric battery in a closed circuit becomes exhausted. Also the gland or the muscle which is stimulated by this constant flow of nervous energy—electricity—would become completely exhausted.

The presence of the synapse which acts as a switch to open and close the circuit is just as important as the spring which breaks the electric current of the door-bell when the pressure is released. Also the presence of the synapse supports the claim that there is an electric potential in the living neurons; that the nerve cells act in the same manner as do accumulators or condensers.

There are also certain electrical results[41] to be found from the passage of a current through the nerve, these are in the form of additional currents which appear in the nerve or in its surface. They are called the electronic currents, and their direction is the same as that of the current which is lead into the nerve. These currents are new and are generated in the nerve itself by the action of the external current. From the above discussion it would follow that a nerve impulse is a special sort of an electrical wave propagated from point to point along the nerve-fiber, and is capable of exciting a muscle-fiber where the termination of the axon comes in contact with the muscle.

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## BIBLIOGRAPHY

[37]Wilhelm Wundt, "Principles of Physiological Psychology," p. 58.

[38]J. D. Lickley, "The Nervous System," p. 14.

[39]DuBois Reymond, "Paper Communicated to the Physiological Society of Berlin," 1845.

[40]Sherrington, "The Interrogative Action of the Nervous System," p. 17.

[41]Ladd and Woodsworth, "Physiological Psychology," p. 139.

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## A REVIEW OF THE STEPS TO BE TAKEN IN MAKING AN EXTERNAL OCULAR INSPECTION

In starting the external ocular inspection the first thing the examiner notes is the general appearance of the eyes. Are they very far apart; or, are they horizontally on plane, one with another, or is one higher than the other? Or is any other type of facial or ocular deformity present? If so, this data should be recorded. The examiner next turns to the orbits themselves, and notes any manifest abnormalities there. This concludes the general external examination of the eye and can readily be done by merely observing the patient while the case history is being taken. We next turn our attention to a more detailed examination of the various parts of the ocular region as seen externally. The writer has found it advisable in making this portion of the examination, to tilt the patient back, at an angle of from thirty to forty-five degrees in an ophthalmic chair. It is of course necessary to have a comfortable head rest and the patient should be fully relaxed, facing a good light. The writer uses a frosted 100 watt daylight lamp on a sliding bracket in addition to a movable spotlight used for focal illumination. It would seem best to start one's detailed examination of the external structures of the eye with a careful inspection of the eyeball itself. Is it deepseated, normal in position, or protruding? If deepseated, a condition called enophthalmos, it probably is due to advanced years, or to the extreme emaciated condition of the patient but may also be the result of a trauma. If protruding, a condition called exophthal-

mos, one should have the patient examined for tumors and other afflictions of the orbital region. This protrusion also is one of the diagnostic points or signs of a form of goitre and when present certain other tests should be made. It is well to remember however, that this protrusion may also result from both injuries and inflammations in the eye and orbit and it is at times caused by a thrombosis in the sinus cavities. Any marked departure from normal calls for a searching examination of the orbit by one specializing in this work.

Finding the eyeballs normal in position we now examine them for size and lack of symmetry. The normal eyeball of a child is from eighteen to twenty-one millimeters in diameter, while that of an adult is from twenty-one to twenty-seven millimeters in diameter.

The examiner next takes the tension of the eyeball. This can be done by means of palpation. We direct the patient to look down and then placing our index finger on the upper lid palpate the sclera above the cornea, pressing downward. The tension is taken by estimating the degree of tension of the eye being examined with that of a normal eye. The tension of each eye is taken this way and recorded, Tn, when the tension is normal, Tn plus, indicating increased tension, Tn minus, diminished tension. This is a very important phase of the external inspection and should never be omitted. The taking of the ocular tension is important, as it is one of the diagnostic tests for glaucoma, an increase in tension indicating that disease and the palpation also gives the examiner information regarding the presence or absence of sensitiveness in the ciliary region. Normally this palpation should cause the patient no inconvenience.

The examiner next proceeds to examine the lids. Naturally the first thing noted is the size of the palpebral fissure. Next the ability to move the lids, looking for a blepharospasm or a ptosis of the lids. Next for an entropion or an extropion and further examining the lid edges for swellings, crusted areas or ulcerations and the lashes for number and signs of trichiasis. The condition and position of the puncta are noted also at this time.

The skin covering the anterior portion of the lids is examined. This is done by means of eversion of the upper and lower lids and the color, surface and transparency of the conjunctiva is noted. Here one looks for ulceration, scars, granulation and thickening, noting any variations from normal. Here one will frequently find ocular infection, and as refractionists we should never prescribe a correction until the infected area is removed. Those of us living in states where trachoma is at all prevalent must be very careful in checking cases for this highly infectious disease.

The anterior portion of the eye is next to be examined. This can best be done by means of focal illumination or with the aid of the slit-lamp. The later method is of course preferred, the new hand instrument being splendid for the purpose, permitting the

examiner to easily view cornea, the aqueous, the iris, and part of the lens. This instrument not being available one can do nicely by means of focal illumination. Here one needs a strong steady source of illumination and a double convex lens. The writer when examining by means of focal illumination has found a plus 13 dioptre double convex sphere, about two inches in diameter, of great value. The rays of light are focused on the area to be examined with this lens while the examiner views the areas through a strong binocular magnifier. In this way small deformities which would escape one's notice under ordinary means of observation can be detected.

The bulbar conjunctiva and the cornea are first examined. Being transparent we look for traces of color, thickening, opacities, scars, inflammation and ulcers. Here is a fruitful field for careful inspection. Many cases coming to us as optometrists do so because of small corneal ulcers which, unless carefully watched for, may pass unnoticed. These small ulcers are usually caused by a focal infection or various bacillus and as soon as such ulcers are noted it becomes the examiner's duty to have the patient's teeth, tonsils and sinus cavities examined as well as to refer him to his family physician for a physical examination. In addition to having the patient examined to find the cause of the ulcers, they themselves must be removed either by surgical methods or by medicinal means, and this must be done at once, to eliminate the dangers of leaving permanent scars which would naturally interfere with the patient's vision.

The size and form of the cornea is also noted and care should be taken to get corneal reflexes with a placidos disc should any corneal irregularity be suspected.

Leaving the cornea we next turn our attention to the sclera and the portion of the conjunctiva covering the sclera. Here the color of the sclera should be bluish white and we note any variations from the normal color. We also look for signs of a staphyloma of the sclera and for episcleritis or scleritis. We carefully note the presence or absence of a pterygium, inasmuch as this common conjunctival growth may be productive of much corneal iregularity, which might puzzle the examiner later on if the cause is not discovered at this time.

The anterior chamber containing the aqueous is next examined for depth and clearness of contents. Here, too, we, as optometrists, must be careful, as two serious ocular diseases can frequently be detected at this point. The first is iritis, an inflammation of the iris which in nearly every case clouds the anterior chamber and gives it the appearance of great depth. The other disease, frequently discernible at this point in the examination, is glaucoma. With the increased intra-ocular tension the anterior chamber will appear very shallow.

The lens is next examined. Its presence or absence is noted, along with its position and color.

Following this the iris is examined. Its position is noted along with any malformations and adhesions. It is important that the iris hang free in the anterior chamber, inasmuch as any attachment will naturally hinder the sphincter pupillae and dilator pupillae muscles of the iris preventing this sensitive organ from functioning as it should. The iris is next examined for signs of iritis. When this diseased condition is present the iris appears dull and sometimes swollen. The usual markings are missing and the structure lacks its usual lustre. The pupil in iritis is contracted and very sluggish in action and will frequently be found to be irregular in shape, and apparently "off center." Iritis in common with corneal ulcers, frequently has its origin in a foci of infection, although it may also be due to syphilitic, rheumatic or diabetic conditions, and the same care should be exercised in handling this type of case as in one of corneal ulcer or glaucoma.

The pupil is next inspected. Its position, shape and general size is noted. The pupil should be circular in shape with a regular outline. Any variation from this normal demands the most careful and painstaking recheck for all types of pathologic conditions.

The final step in the external ocular inspection is made in taking the pupillary reactions. This is very important and should be done without fail in every case, as in many respects the examiner will receive from these simple tests information of real value in making his diagnosis. The first test is the pupillary reaction to light. This test is simply made by exposing the eye to the rays of a moderately strong light. Normally the pupil will contract. However, in cases of iritis and in the first stages of glaucoma the reaction will be very sluggish. In a glaucomatous attack there will be no reaction at all to light. The second test is the pupillary reaction test to accommodation and convergence. This test like the other is easily made by merely holding some small object from six to ten inches before the patient having them fix upon it. Normally the pupils will be seen to contract. Under certain conditions the pupil will respond to accommodation but not to light. This is called an Argyle-Robertson pupil and is caused by either a mydriatic having been a short time previously instilled or by the patient being afflicted with locomotor-ataxia.

The pupillary reflexes are a splendid help in diagnosing nervous disorders and brain lesions and marked changes in size and equality of the pupils should be carefully watched.

These few simple check tests comprising the external ocular inspection can easily be made. They take but a few moments to do and give so much of real value in the way of differentiating the normal eye, free from pathology from the one suffering from some form of pathology, that they should never be omitted.

C. C. K.

# ANNOTATIONS AND SOCIETY PROCEEDINGS

The American Journal of Optometry is the Official Organ of the American Academy of Optometry, as well as the Organ of the Arkansas, Delaware, Indiana, Iowa, Maine, Maryland, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Pennsylvania, South Dakota, Vermont and West Virginia Optometric Associations.

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## UNIVERSITY OF CALIFORNIA

After a survey of schools of Optometry in the United States, the Department of Physics-Optometry at the University of California has drawn up a revised curriculum which has recently received the approval of the University. The program, as in the past, is a four-year program leading both to a bachelor's degree and a certificate of completion of the curriculum in Optometry. An outline of the proposed course is given below:

### FRESHMAN YEAR

Subject A—An examination in Subject A (English composition) is required of all undergraduate entrants.

Military Science 1A-1B—Practical and theoretical instruction in infantry drill, ceremonies, marksmanship, first aid, command, leadership and teamwork to include the training of the individual soldier.

Physical Education.

Chemistry 1A-1B—General chemistry, including qualitative analysis.

English 1A-1B—English 1A: Training in writing. English 1B: An introduction to the later study of literature, together with further practice in writing.

Mathematics 5—Analytic geometry. The straight line, the circle, and the conic sections, including a discussion of the general equation of the second degree.

Physics 2A-2B—General physics lectures, with experimental illustration and problems. Properties of matter, mechanics, heat, sound, light, electricity and magnetism.

Elective.

### SOPHOMORE YEAR

Military Science 2A-2B—Continuation of course 1A-1B, emphasis on leader-

ship, teamwork and the duties of non-commissioned officers. Musketry, scouting and patrolling; interior guard duty; the automatic rifle; command; leadership and teamwork to include the training of the squad leader.

Physical Education.

Psychology 1A-1B—General psychology with laboratory work second semester.

Physics 3A-3B—Mechanics, properties of matter, heat, sound, light- electricity, magnetism. Experimental work planned to accompany the lectures 2A-2B.

Physiology 1—The physiology of muscle, peripheral, nerve, central nervous system, sensation, circulation, respiration and digestion.

Foreign language.

Elective.

## JUNIOR YEAR

American Institutions 101—The formation, sources and development of the national and state constitutions, the American executives, the national and state administrative systems, American legislative bodies, the national and state judicial systems, American territories and dependencies, American citizenship, the party system, and local government institutions.

Anatomy 102—General human anatomy. Demonstration and laboratory study of prepared human dissections, models and microscopic slides. For students of public health and physical education.

Physics 108A-108B—108A—Geometrical Optics. Geometrical methods applied to the optics of mirrors, prisms and lenses. Experimental lectures and laboratory work. 108B—Physical Optics. Lectures with experimental illustrations and laboratory work dealing with the phenomena of diffraction, interference, polarization and their application.

Physics 111A (or 111B)—111A—Electric Discharge Through Gases. An introduction to atomic physics, treating the conduction of electricity by gases, cathode rays and positive ray analysis, thermionic emissions, the photo-electric effect and X-rays. Lectures illustrated with problems and experiments. 111B—Radioactivity and Atomic Structure. Radioactive substances and transformations, alpha, beta, and gamma rays, the nuclear atom, and X-ray spectra. Lectures, experimentally illustrated.

Physiology 115—Anatomy and Physiology of the Eye. Lectures: Structure and physiological functions. Laboratory: Dissection of the ox and human eye; physiological experiments on refraction and accommodation.

Optometry 401A-401B—Practical optics. Lectures: History of the development of lenses and spectacles; the manufacture of optical glass; the optical properties of different glasses; the theory of the design and grinding of spectacle lenses. Laboratory: Lens surfacing, edging, beveling, mounting and neutralization of lenses; frame fitting.

Optometry 102A-102B—Elementary Theoretical Optometry. History of Optometry; principles and methods used to detect errors in ocular refraction; description, construction and manipulation of optical instruments used to detect, measure and remedy ocular anomalies.

Elective.

## SENIOR YEAR

Optometry 101—Advanced Geometrical Optics. The mathematical development of the Gauss theories of image formation by optical systems.

Optometry 105A-105B—Optics of Vision. The phenomena of vision, including consideration of the physical, physiological and psychological factors; theories of accommodation, convergence, monocular and binocular vision, color vision, and related subjects.

Optometry 103A-103B—Advanced Theoretical Optometry.

Optometry 404A-404B—Practical Optometry. Lectures with demonstrations. Use of mechanical appliances, for making examination of eyes, study of optical condition of eyes, lens fitting.

Optometry 406—Optometry Clinic. Complete physical eye examinations. The adaptation of lenses to the defective eye.

Optometry 407—Pathology of the Eye. Lectures dealing with the identification of pathological conditions in the eye, and the manifestation of organic disease as indicated by the eye.

Optometry 408—Perimetry. Lectures and demonstrations dealing with the technique of field measurements including the standardization of the physical and psychological factors involved. Normal and abnormal color fields.

Elective.

It will be noted that the first two years' work is devoted to instruction in the fundamental subjects which form the foundation of Optometric practice. Thorough courses in physics, physiology and psychology with sufficient mathematics form the basis of the first two years' work. The preparation is broad enough so that during the last two years in addition to the professional courses in Optometry, the student may elect more advanced courses in any one of these three divisions. If his special interest is in the design of instruments he may specialize in physics. If he is interested in the physiology of muscle action he may elect advanced courses in general physiology. If his special interest is in the psychological phenomena of vision he is prepared for the advanced courses in that field. It is hoped to introduce a short course during the Spring semester of the sophomore year which will give the teaching staff contact with the oncoming group of students and the prospective student some idea as to what Optometry is like before the regular courses begin. We are also looking forward with interest to a course in perimetry to come in the senior year which will be given by Dr. T. A. Brombach. The Optometry clinic is open throughout the academic year. In addition to the instruction received by the regular members of the teaching staff, the senior students will also have the benefit of the experience of several of the Optometrists in practice in the Bay Region who have generously volunteered to give one morning a week for various periods of time to this work.

The clinical equipment has recently been increased by the installation of one complete American Optical Company unit, one complete General Optical Company unit, and in addition the Bausch and Lomb Keratometer and the Bausch and Lomb large Gullstrand ophthalmoscope provided with both a binocular eyepiece and a demonstration eyepiece. The demonstration eyepiece enables two people, the instructor and a student, or the instructor and a patient to observe the fundus at the same time.

In the original draft of the program in Optometry, it was not only allied with the Department of Physics but contained in the requirements for the degree several courses of a mathematical nature highly important for the students going on in physics but having little bearing on the training in Optometry. In the new program

these courses have been eliminated and the emphasis focused on the main objective of the curriculum—the training of Optometrists for work in three fields—refraction, muscle exercises for the correction of eye trouble without glasses and field measurements so that those who need medical or dental attention may be referred to specialists in these fields.

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AMERICAN ACADEMY OF OPTOMETRY

The Executive Council of the American Academy of Optometry has, during the past month, been active in raising a sum of money with which to establish a Research Fellowship at one of our large educational centers. All members of the Academy have been called upon to contribute to this fund and the announcement has been made that the response on the part of the members has been very gratifying.

The Academy will hold its annual meeting in Boston in December of this year, where the details for the establishment of this Research Fellowship will be fully worked out.

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NORTH DAKOTA ASSOCIATION

The annual convention of the North Dakota Optometric Association was held in Fargo, August 5th and 6th. Twenty-seven optometrists atented a two day session at which Dr. C. C. Koch of Minneapolis was the chief speaker.

Dr. L. G. Power of Minot was re-elected president at the business session with Dr. Wm. Henning of Fargo as first vice-president; Dr. C. P. Elliott of Valley City, second vice-president; Dr. A. S. Anderson of Minot, secretary, and Dr. Andrew Lee of Carrington, treasurer.

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OPTOMETRICAL ASSOCIATION OF ONTARIO

Dr. Edward Bind, Secretary of the Optometrical Association of Ontario, announces that the summer convention of this society will be held at the Royal-York Hotel at Toronto on September 6th and 7th. The following men will address the convention: Dr. F. J. Conboy, on "Building a Profession"; Dr. Wilfrid T. Gratton, on "Clinic of Pathological Cases"; Dr. J. C. Thompson, on "The Development of the College of Optometry"; Dr. Ivan S. Nott, on "Myopia with Esophoria"; and Dr. Edward Bind, on "Charting the Visual Fields." The registration fee will be five dollars ($5.00).

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